PATENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 26 April 2000 (26.04.00)	
International application No. PCT/EP99/06288	**Applicant's or agent's file reference** 822J PCT 389
International filing date (day/month/year) 26 August 1999 (26.08.99)	**Priority date** (day/month/year) 28 August 1998 (28.08.98)
Applicant PIRIM, Patrick	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

24 March 2000 (24.03.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer F. Baechler
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

EP9906288

NIL

PATENT COOPERATION TREATY

20 NOV 2000

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
822J PCT 389		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/06288	26/08/1999	28/08/1998
International Patent Classification (IPC) or national classification and IPC		
H04N7/26		
Applicant		
HOLDING B.E.V. SA et. al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 13 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
24/03/2000	16.11.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Weber-Kluz, F Telephone No. +49 89 2399 8630

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/06288

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-110	as originally filed			

Claims, No.:

1-28	as received on	01/09/2000	with letter of	30/08/2000

Drawings, sheets:

1/17-17/17	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   - ☐ the description, pages:
   - ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☒ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:
see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☒ all parts.

☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-28
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-27
	No:	Claims	28

Industrial applicability (IA) Yes: Claims 1-28
No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item IV

Lack of unity of invention

Claims 1 to 27 concern a process and a device for compressing and decompressing input digital video signals and claim 28 concerns an apparatus for processing digitally encoded video data comprising one sequential buffer memory. Claim 28 does not mention any compression or decompression. Therefore no relationship between claim 28 (in as far as the scope of claim 28 can at present be determined) and the other claims can be seen.
It thus appears that the claims are not so linked as to form a single general inventive concept (Rule 13.1 PCT).

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Claims 1 to 27:

These claims recite a process and a device which ensure an improved compression/decompression of images with moving areas, delimiting the contour of moving zones with the precision of a single pixel, without block effect. In particular the claimed process and device operate on single individual pixels. None of the documents cited in the ISR (which all use blocks of pixels) discloses or suggests such a specific treatment of individual pixels. Due to this pixel by pixel treatment the viewed image has a more pleasant aspect.

Therefore it is considered that the subject-matter of claims 1 to 27 is new and involves an inventive step.

The requirements of Article 33(4) PCT are met.

Claim 28:

Reference is made to the following document:
D1: EP - A - 0 543 197

D1 discloses an apparatus for processing digitally encoded video (see figure 1 of D1). In this apparatus the buffer (16) is of size slightly more than one frame, the additional memory being function of a maximum amplitude of motion encodable in pixels in the buffer (see column 9, line 53 to column 10, line 18). In this buffer the digital data are looped and data are delivered in a sequential mode to said buffer (see column 10, line 19 to column 11, line 1 and figures 8A to 8B).

D1 differs from the subject-matter of claim 28 in that the buffer has a plurality of output ports. Therefore the subject-matter of claim 28 (in as far as the scope of claim 28 can at present be determined) is new.

Nevertheless D1 (see column 7, lines 20 to 22) suggests to have fewer output ports. Therefore no significant difference, which could constitute an inventive step, between D1 and the subject-matter of claim 28 (in as far as the scope of claim 28 can at present be determined) can be seen.

The requirements of Article 33(4) PCT are met.

Re Item VII
Certain defects in the international application

The description (see pages 13 to 41) is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

Re Item VIII
Certain observations on the international application

The category of claim 28 is not clear: is claim 28 an apparatus claim or a process claim

(circuitry and/or software). In the case where a circuitry is claimed, the subject-matter of claim 28 is not clear, since claim 28 attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem; the technical features necessary for achieving this result should be added.

CLAIMS

1. A process for compressing input digital video signals and for decompressing compressed binary signals resulting from such a compression, said input digital video signals having at least a luminance component and being formed by a succession of corresponding frames, each representing a video picture and formed by a succession of pixels,

• whereas this compression process consists in looking for the displacements and the sudden modifications in the different corresponding pixels, between two successive frames of the input digital video signals to be encoded, and consisting in deducting from the said displacements and from the said sudden modifications, an encoded signals which comprises, for the initial sequence and for each following sequence of the digital signals beginning with a modification in the video picture represented by the said digital video signals, in a given frame with respect to the previous frame,

on the one hand, at the beginning of sequence, as well as for the pixels suddenly modified in value, at least the said frame or the said pixels of the said digital signals to be encoded, without any modification, and

on the other hand, throughout the sequence up to the beginning of the following sequence, a succession of correction bit packets,

said compression process including:

- a preliminary encoding operation of the said input digital video signals using a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signals, in order to obtain a succession of mosaic encoded digital signals encoding the said signals in the form of a succession of picture mosaics,

- an encoding operation for producing a flow of binary signals from the succession of mosaic encoded digital signals,

- a compression operation of the flow of binary signals in order to produce compressed binary signals as to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is

determined within both possible values of such signals, and

• whereas this decompression process consists in decompressing digital signals composed of the compressed binary signals resulting from the said compression process, i.e. comprising for each sequence at least a first digital signals frame, not modified by the said compression process, followed by a succession of correction bit packets,

said decompression process including:

- a decompression operation of the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression operation, of the majority of binary signals of determined value,
- a decoding operation of the said flow of binary signals producing a succession of mosaic encoded digital signals,
- a final decoding operation reconstructing, from a succession of picture mosaic encoded type signals, a digital video signals formed by a succession of frames, each made of a succession of pixels,

characterised in that

• as the compression process is concerned, it comprises, moreover, at least as regards the luminance component, an additional encoding operation, applied to the succession of picture mosaic encoded digital signals resulting from the preliminary encoding operation, which is sensitive to the displacements of the contours in the said successive pictures and which consists, for each pixel of a frame, said additional encoding operation using:

a) deduction from the said succession of mosaic encoded digital signals of the correction bit packets as packets of binary signals representative of a global modification or not of the pictures between frames and of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any, said deduction being done by subjecting the said preliminary encoded digital signals, one frame at a time:

- to a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- to a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels,

- to a process for deducting, for the said moving pixels, the amplitude and the oriented direction of the displacement,

b) a restoration of the position of the pixel if it has been displaced,

c) a check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,

d) a memorisation of the result of this check, and

e) a transfer for compression operation, either, of the said packet of binary signals representative in case of compliance, or of the picture mosaic encoded signals from the said wavelet filter in case of non-compliance; and

- as the decompression process is concerned, it comprises, moreover, a preliminary decoding operation, which is applied to the said flow of decompressed binary signals, and which,

a) causes initially to circulate over a loop, from an input position on this loop, signals of the said flow of the mosaic type corresponding to a first frame of the

video signals to be reconstructed and resulting from the said decompression operation, whereas the travel duration of the said signals over the said loop is equal to that of a frame of the video signals to be reconstructed, each signals of a frame circulating normally in the loop as long as no modification and no displacement is signalled in the decompressed binary signals,

b) repositions in the said loop, the pixels having undergone a displacement signalled by a group of digital signals representing, in the flow of decompressed binary signals, the amplitude and the oriented direction of the displacement, also resulting from the said decompression operation,

c) replaces the picture mosaic type signals in circulation over the said loop with the new signals of this type as they arrive,

d) extracts for transmission to the final decoding operation, from an output position on this loop located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning of the pixels.

2. A process according to claim 1, characterised in that it uses, for the compression and decompression processes,

- the preliminary encoding operation of the succession of the digital video signals into a succession of mosaic encoded digital signals corresponding to the scanning, in each frame, of the Mallat diagram and making up the picture mosaic, using a wavelet filter;
- the compression operation, using a compression-decompression assembly, with an adaptive quantifier, *RCL* type encoder and *CH* encoder, Huffman encoder type, operating in compression,
- the decompression operation, using a compression-decompression assembly, with an adaptive quantifier, *RCL* type encoder and *CH* encoder, Huffman encoder type, operating in decompression,
- the final decoding operation, using a reverse-operation wavelet filter.

3. A process according to claim 1 or 2, characterised in that the said preliminary decoding operation causes the said signals to circulate over a loop

with a travel duration equal to the duration of a frame of this signals, causes the said signals, during its travel over the said loop, to pass through a pixel position matrix the number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signals is injected into the said loop at a central position of the said matrix, in bringing back, after running the said first frame of each sequence, within the said central position, a pixel of the said signals, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the correction bits packet regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and extracts from the said loop, in a position located downstream, in the running direction, of the said central position, the successive frames thus restored.

4. A process according to any one of the claims 1 to 3, characterised in that the said packet of correction digital signals comprises for each pixel four groups of signals:

- the first consists of a single binary signals whereby one of both possible values of which represents a global modification of the pictures between a frame and the previous frame and the other value a global non-modification, said first one signalling the necessity of global correction or the non-necessity of such a correction,
- the second consists of a single binary signals whereby one of both possible values of which represents a displacement for the pixel and the other value a non-displacement, said second one, and,
- both other two consist of digital signals with a limited number of bits and represent, one the quantified amplitude and the other the quantified oriented direction of the displacement if any.

5. A process according to claim 4, characterised in that the additional encoding operation comprises the steps of:

a) encoding the said digital signals, one pixel at a time, in relation to the value variation of each pixel between the frame processed and the previous frames by implementing for each pixel, a block of four digital signals among which

- the first one, which is a binary signals, represents, by both its possible values, either the necessity of global correction or the non-necessity of such a correction,
- the second one, who is also a binary signals, appears exclusively when the said first signals represents the non-necessity of global correction and it then represents, by both its possible values, either a displacement or a non-displacement, and
- the other two, which are both digital signals with a limited number of bits, appear exclusively when the said first signals represents the non-necessity of correction and they then represent, one the quantified amplitude and the other the quantified oriented direction of the displacement in a zone of the composite frame involved;

b) determine whether the proportion, in each successive frame, of the number of pixels for which the said first binary signals has the value representative of a correction necessity with respect to the total number of pixels in the frame, exceeds a determined percentage; and

c) transmitting, one frame after the other, to the said compression operation:

- if the said percentage is not exceeded, the said block of signals related to the pixel affected,
- if the said percentage is exceeded, the mosaic encoded digital signals generated by the preliminary encoding operation.

6. A process according to any one of the claims 1 to 5, characterised in that the said preliminary decoding operation uses in the said loop a square matrix whose odd number of lines and whose number of columns are respectively smaller than the number of lines and the number of columns of a frame of the video signals to be reconstructed, whereas both these numbers are greater, at least by one unit, than the number of quantification levels of the

said displacement amplitude, and through which circulate the signals from the said decompression operation, and the position of the pixels having been displaced is restored, whereas they are subject in the said matrix to a reverse direction translation whose quantified amplitude and whose quantified oriented direction are specified by the digital values of said both other groups of signals.

7. A device for compressing an input digital video signals having at least a luminance component and formed by a succession of corresponding frames, each representing a video picture and formed by a succession of pixels, as well as for decompressing compressed binary signals in a device of this type, operating in compression,

• whereas this compression and decompression device comprises for the compression:

- at least one preliminary encoding wavelet filter (11) of the said digital video signals performing a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signals, in order to obtain a succession of mosaic encoded digital signals encoding the said signals in the form of a succession of picture mosaics,

- an encoding assembly for producing a flow of binary signals from the succession of mosaic encoded digital signals,

- a compression assembly (13/CP) for compressing the flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals, and

• whereas this compression and decompression device comprises for the decompression:

- a decompression assembly (13/DP) for decompressing the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression assembly, of the majority of binary signals of determined value,

- a decoding assembly producing a succession of mosaic encoded digital

signals,

- a final decoding assembly composed of a reverse-operating wavelet filter, which reconstructs, from wavelets representing in the form of picture mosaics, a digital video signals, the said digital video signals,

characterised in that

• for the compression, it comprises, moreover, at least as regards the luminance component in the said input digital video signals, an additional encoding assembly (12 A), whose input (20) is connected to the output (16) of the said wavelet filter (11) and whose output (24) is connected to the input (25) of the said compression assembly (13/CP), whereas this assembly is sensitive to the displacements of the contours in the said successive pictures represented by the said succession of encoded signals with mosaic pictures received at the input and comprising, in order to process each pixel of a frame,

a) means (21) to deduct from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any, said means being:

- means (21*a*) for a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signals *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signals *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- means (21*b*) for a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which

simultaneously the said first signals *DP* exhibits the said first value representing the overrun of the said threshold and the said second signals *CO* varies significantly between neighbouring pixels, where as both these processes, time-related and space-related, and

- means (21c) to deduct, from the said moving pixels, on the one hand, the first value, representative of a displacement, for the said second binary signals and, on the other, the digital values of said both other digital groups among the said four groups of digital signals,

b) means (34) to restore the position of the pixel if it has been displaced,

c) means (39) to check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,

d) means to memorise the result of this check, and

e) means (40) to transfer to the said compression assembly (13/CP) either the said packet of signals representative in case of compliance, or the picture mosaic encoded signals from the said wavelet filter in case of non-compliance; and,

• for the decompression, it comprises, moreover, a preliminary decoding assembly, whose input is connected to the output of the said decompression assembly and whose output is connected to the reverse input of the said wavelet filter, which comprises:

a) a loop (50-51-52) whose input (34c) receives, from the said decompression assembly (13/DP), the said reconstructed flow of binary signals, which starts with a picture mosaic type signals corresponding to a first frame of the video signals to be reconstructed and which circulates in the form of a picture mosaic type signals, whereas the travel duration of the said signals over the said loop is equal to that of a frame of the video signals to be reconstructed,

b) means (70) to reposition, in the said loop, the pixels having undergone a displacement indicated by a group of digital signals which represent, in the said reconstructed flow of digital signals, the amplitude and the displacement

direction,

c) means (203) to replace the picture mosaic type signals in circulation in the loop with the new signals of this type as they arrive, and

d) means to transmit to the final decoding operation, from an output (35) located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning.

8. A device according to claim 7, characterised in that, for the decompression, the said preliminary decoding assembly comprises:

- means to cause to circulate normally, in a loop (50-51-52), a frame of the said decompressed signals, but encoded, received from the said decompression portion of the said compression-decompression assembly as long as both binary signals represent simultaneously an absence of correction and an absence of movement,
- means to replace, in the said loop, the frame in circulation, with a new frame arriving with new pixel values, in case when the binary correction signals indicates the necessity of a correction,
- means to perform, in a square matrix (50), whose odd number of lines and of columns is smaller than the number of lines and of columns of a frame, whereas both these numbers are greater than, by at least one unit, the number of quantification levels of the said displacement amplitude, and through which circulate the said decompressed signals, a translation operation of the moving pixels within the said matrix from their position to the centre position of pixel in the said matrix, in case when the said first binary correction signals indicates an absence of correction while the said second binary displacement signals indicates a displacement.

9. A device according to claim 7 or 8, characterised it comprises means (203) to cause the said digital signal encoded at the input to circulate over a loop (50-51-52), whose travel duration needed by the said signal is equal to the duration of a frame of this signal, means to cause the said signal, during its travel over the said loop, to pass through a pixel position matrix (50) the

number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signal is injected into the said loop at a central position (60) of the said matrix (50), means (70) to bring back, after running the said first frame of each sequence, within the said central position (60) a pixel of the said signal, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the packet of correction bits regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and means to extract from the said loop, in a position (35) located downstream, in the running direction, of the said central position (60), the successive frames thus restored.

10. A video compression apparatus, comprising:

- a motion analysis stage, comprising circuitry and/or software designed to identify a pixel of a current frame of a video whose contents correspond to a different pixel of a previous frame of the video, and designed to produce a datum coding motion between the pixel of the previous frame and the pixel of the current frame; and
- at least one other video processing stage of circuitry and/or software interconnected with the motion analysis stage to effect compression of the video.

11. The apparatus of claim 10, wherein the motion analysis stage further comprises circuitry and/or software designed to identify a pixel of the current frame whose contents corresponds to the same pixel of the previous frame.

12. The apparatus of claim 11, wherein the corresponding content is identified when a numerical value of the pixel of the current frame differs from the pixel of the previous frame within a threshold tolerance.

13. The apparatus of claim 11, wherein a datum coding the pixel of the current frame whose contents corresponds to the same pixel of the previous frame is entirely zeros.

14. The apparatus of claim 10, wherein the motion analysis stage further comprises circuitry and/or software designed to convey a content of one pixel of the current frame instead of the datum coding motion of the one pixel.

15. The apparatus of claim 14, wherein the one pixel is selected because of a large change in the content of the one pixel.

16. The apparatus of claim 10, wherein the motion is encoded as a spatial displacement between the pixel of the previous frame and the pixel of the current frame.

17. The apparatus of claim 16, wherein the spatial displacement is encoded as a direction and distance.

18. The apparatus of claim 10, further comprising:

a decoder designed to decode motion coding data produced by the motion analysis stage;

a comparator designed to compare the decoded motion generated by the decoder to a representation of input to the motion analysis stage; and

circuitry and/or hardware controlled by the comparator.

19. The apparatus of claim 18, wherein the circuitry controlled by the comparator introduces corrections in a representation of the stored motion stored in the decoder.

20. The apparatus of claim 18, wherein the circuitry controlled by the comparator is designed to increase a compression factor of the apparatus by introducing noise into the compression of the video.

21. The apparatus of claim 18, wherein the circuitry controlled by the comparator suppresses a motion coding datum, and replaces it with a less-encoded datum for a corresponding portion of the video.

22. The apparatus of claim 10, further comprising:

a wavelet coder upstream of the motion analysis stage.

23. The apparatus of claim 10 or 22, further comprising a run-length coder downstream of the motion analysis stage.

24. The apparatus of claim 10, wherein the motion analysis stage analyses a luminance channel of the video.

25. The apparatus of claim 24, wherein chrominance channels of the video are not analysed in the motion analysis stage.

26. The apparatus of claim 24, wherein chrominance channels of the video are compressed based on the analysis of the luminance channel.

27. The apparatus of claim 24, wherein chrominance channels of the video are compressed according to an intensity change during the stage that analyses the luminance channel.

28. Apparatus for processing digitally encoded video, comprising:

one sequential buffer memory of the size of at least one frame plus 2n lines 2n+1 pixels, where n is the maximum amplitude of motion, digitally encodable in the video pixels, in said buffer memory, said memory having only one operational entry port and one operational output port;

means for delivering to said buffer memory, in a sequential mode on said single entry port, successive pixel values of successive frames of said digitally encoded video; and

circuit and/or software for replacing pixel values in a current video frame at least partially stored, in a sequential mode, in said buffer memory, with pixel values from a previous frame at least partially stored, in a sequential mode, in said buffer memory, in compliance with digital control data, representative of the pixel motion, encoded in said buffer memory.

PATENT COOPERATION TREATY

17 NOV 2000

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

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875

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	16.11.2000
Applicant's or agent's file reference 822J PCT 389	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/06288	26/08/1999	28/08/1998

Applicant
HOLDING B.E.V. SA et. al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
822J PCT 389		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/06288	26/08/1999	28/08/1998
International Patent Classification (IPC) or national classification and IPC		
H04N7/26		
Applicant		
HOLDING B.E.V. SA et. al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 13 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
24/03/2000	16.11.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Weber-Kluz, F Telephone No. +49 89 2399 8630

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/06288

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:

Description, pages:

1-110 as originally filed

Claims, No.:

1-28 as received on 01/09/2000 with letter of 30/08/2000

Drawings, sheets:

1/17-17/17 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☒ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:
see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☒ all parts.

☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-28
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-27
	No:	Claims	28

Industrial applicability (IA) Yes: Claims 1-28
No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item IV

Lack of unity of invention

Claims 1 to 27 concern a process and a device for compressing and decompressing input digital video signals and claim 28 concerns an apparatus for processing digitally encoded video data comprising one sequential buffer memory. Claim 28 does not mention any compression or decompression. Therefore no relationship between claim 28 (in as far as the scope of claim 28 can at present be determined) and the other claims can be seen.
It thus appears that the claims are not so linked as to form a single general inventive concept (Rule 13.1 PCT).

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Claims 1 to 27:

These claims recite a process and a device which ensure an improved compression/decompression of images with moving areas, delimiting the contour of moving zones with the precision of a single pixel, without block effect. In particular the claimed process and device operate on single individual pixels. None of the documents cited in the ISR (which all use blocks of pixels) discloses or suggests such a specific treatment of individual pixels. Due to this pixel by pixel treatment the viewed image has a more pleasant aspect.

Therefore it is considered that the subject-matter of claims 1 to 27 is new and involves an inventive step.

The requirements of Article 33(4) PCT are met.

Claim 28:

Reference is made to the following document:
D1: EP - A - 0 543 197

D1 discloses an apparatus for processing digitally encoded video (see figure 1 of D1). In this apparatus the buffer (16) is of size slightly more than one frame, the additional memory being function of a maximum amplitude of motion encodable in pixels in the buffer (see column 9, line 53 to column 10, line 18). In this buffer the digital data are looped and data are delivered in a sequential mode to said buffer (see column 10, line 19 to column 11, line 1 and figures 8A to 8B).

D1 differs from the subject-matter of claim 28 in that the buffer has a plurality of output ports. Therefore the subject-matter of claim 28 (in as far as the scope of claim 28 can at present be determined) is new.

Nevertheless D1 (see column 7, lines 20 to 22) suggests to have fewer output ports. Therefore no significant difference, which could constitute an inventive step, between D1 and the subject-matter of claim 28 (in as far as the scope of claim 28 can at present be determined) can be seen.

The requirements of Article 33(4) PCT are met.

Re Item VII
Certain defects in the international application

The description (see pages 13 to 41) is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

Re Item VIII
Certain observations on the international application

The category of claim 28 is not clear: is claim 28 an apparatus claim or a process claim

(circuitry and/or software). In the case where a circuitry is claimed, the subject-matter of claim 28 is not clear, since claim 28 attempts to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem; the technical features necessary for achieving this result should be added.

CLAIMS

1. A process for compressing input digital video signals and for decompressing compressed binary signals resulting from such a compression, said input digital video signals having at least a luminance component and being formed by a succession of corresponding frames, each representing a video picture and formed by a succession of pixels,

• whereas this compression process consists in looking for the displacements and the sudden modifications in the different corresponding pixels, between two successive frames of the input digital video signals to be encoded, and consisting in deducting from the said displacements and from the said sudden modifications, an encoded signals which comprises, for the initial sequence and for each following sequence of the digital signals beginning with a modification in the video picture represented by the said digital video signals, in a given frame with respect to the previous frame,

on the one hand, at the beginning of sequence, as well as for the pixels suddenly modified in value, at least the said frame or the said pixels of the said digital signals to be encoded, without any modification, and

on the other hand, throughout the sequence up to the beginning of the following sequence, a succession of correction bit packets,

said compression process including:

- a preliminary encoding operation of the said input digital video signals using a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signals, in order to obtain a succession of mosaic encoded digital signals encoding the said signals in the form of a succession of picture mosaics,

- an encoding operation for producing a flow of binary signals from the succession of mosaic encoded digital signals,

- a compression operation of the flow of binary signals in order to produce compressed binary signals as to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is

determined within both possible values of such signals, and

• whereas this decompression process consists in decompressing digital signals composed of the compressed binary signals resulting from the said compression process, i.e. comprising for each sequence at least a first digital signals frame, not modified by the said compression process, followed by a succession of correction bit packets,

said decompression process including:

- a decompression operation of the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression operation, of the majority of binary signals of determined value,

- a decoding operation of the said flow of binary signals producing a succession of mosaic encoded digital signals,

- a final decoding operation reconstructing, from a succession of picture mosaic encoded type signals, a digital video signals formed by a succession of frames, each made of a succession of pixels,

characterised in that

• as the compression process is concerned, it comprises, moreover, at least as regards the luminance component, an additional encoding operation, applied to the succession of picture mosaic encoded digital signals resulting from the preliminary encoding operation, which is sensitive to the displacements of the contours in the said successive pictures and which consists, for each pixel of a frame, said additional encoding operation using:

a) deduction from the said succession of mosaic encoded digital signals of the correction bit packets as packets of binary signals representative of a global modification or not of the pictures between frames and of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any, said deduction being done by subjecting the said preliminary encoded digital signals, one frame at a time:

- to a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- to a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels,

- to a process for deducting, for the said moving pixels, the amplitude and the oriented direction of the displacement,

b) a restoration of the position of the pixel if it has been displaced,

c) a check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,

d) a memorisation of the result of this check, and

e) a transfer for compression operation, either, of the said packet of binary signals representative in case of compliance, or of the picture mosaic encoded signals from the said wavelet filter in case of non-compliance; and

• as the decompression process is concerned, it comprises, moreover, a preliminary decoding operation, which is applied to the said flow of decompressed binary signals, and which,

a) causes initially to circulate over a loop, from an input position on this loop, signals of the said flow of the mosaic type corresponding to a first frame of the

video signals to be reconstructed and resulting from the said decompression operation, whereas the travel duration of the said signals over the said loop is equal to that of a frame of the video signals to be reconstructed, each signals of a frame circulating normally in the loop as long as no modification and no displacement is signalled in the decompressed binary signals,

b) repositions in the said loop, the pixels having undergone a displacement signalled by a group of digital signals representing, in the flow of decompressed binary signals, the amplitude and the oriented direction of the displacement, also resulting from the said decompression operation,

c) replaces the picture mosaic type signals in circulation over the said loop with the new signals of this type as they arrive,

d) extracts for transmission to the final decoding operation, from an output position on this loop located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning of the pixels.

2. A process according to claim 1, characterised in that it uses, for the compression and decompression processes,

- the preliminary encoding operation of the succession of the digital video signals into a succession of mosaic encoded digital signals corresponding to the scanning, in each frame, of the Mallat diagram and making up the picture mosaic, using a wavelet filter;
- the compression operation, using a compression-decompression assembly, with an adaptive quantifier, *RCL* type encoder and *CH* encoder, Huffman encoder type, operating in compression,
- the decompression operation, using a compression-decompression assembly, with an adaptive quantifier, *RCL* type encoder and *CH* encoder, Huffman encoder type, operating in decompression,
- the final decoding operation, using a reverse-operation wavelet filter.

3. A process according to claim 1 or 2, characterised in that the said preliminary decoding operation causes the said signals to circulate over a loop

with a travel duration equal to the duration of a frame of this signals, causes the said signals, during its travel over the said loop, to pass through a pixel position matrix the number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signals is injected into the said loop at a central position of the said matrix, in bringing back, after running the said first frame of each sequence, within the said central position, a pixel of the said signals, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the correction bits packet regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and extracts from the said loop, in a position located downstream, in the running direction, of the said central position, the successive frames thus restored.

4. A process according to any one of the claims 1 to 3, characterised in that the said packet of correction digital signals comprises for each pixel four groups of signals:

- the first consists of a single binary signals whereby one of both possible values of which represents a global modification of the pictures between a frame and the previous frame and the other value a global non-modification, said first one signalling the necessity of global correction or the non-necessity of such a correction,
- the second consists of a single binary signals whereby one of both possible values of which represents a displacement for the pixel and the other value a non-displacement, said second one, and,
- both other two consist of digital signals with a limited number of bits and represent, one the quantified amplitude and the other the quantified oriented direction of the displacement if any.

5. A process according to claim 4, characterised in that the additional encoding operation comprises the steps of:

a) encoding the said digital signals, one pixel at a time, in relation to the value variation of each pixel between the frame processed and the previous frames by implementing for each pixel, a block of four digital signals among which

- the first one, which is a binary signals, represents, by both its possible values, either the necessity of global correction or the non-necessity of such a correction,

- the second one, who is also a binary signals, appears exclusively when the said first signals represents the non-necessity of global correction and it then represents, by both its possible values, either a displacement or a non-displacement, and

- the other two, which are both digital signals with a limited number of bits, appear exclusively when the said first signals represents the non-necessity of correction and they then represent, one the quantified amplitude and the other the quantified oriented direction of the displacement in a zone of the composite frame involved;

b) determine whether the proportion, in each successive frame, of the number of pixels for which the said first binary signals has the value representative of a correction necessity with respect to the total number of pixels in the frame, exceeds a determined percentage; and

c) transmitting, one frame after the other, to the said compression operation:

- if the said percentage is not exceeded, the said block of signals related to the pixel affected,

- if the said percentage is exceeded, the mosaic encoded digital signals generated by the preliminary encoding operation.

6. A process according to any one of the claims 1 to 5, characterised in that the said preliminary decoding operation uses in the said loop a square matrix whose odd number of lines and whose number of columns are respectively smaller than the number of lines and the number of columns of a frame of the video signals to be reconstructed, whereas both these numbers are greater, at least by one unit, than the number of quantification levels of the

said displacement amplitude, and through which circulate the signals from the said decompression operation, and the position of the pixels having been displaced is restored, whereas they are subject in the said matrix to a reverse direction translation whose quantified amplitude and whose quantified oriented direction are specified by the digital values of said both other groups of signals.

7. A device for compressing an input digital video signals having at least a luminance component and formed by a succession of corresponding frames, each representing a video picture and formed by a succession of pixels, as well as for decompressing compressed binary signals in a device of this type, operating in compression,

• whereas this compression and decompression device comprises for the compression:

- at least one preliminary encoding wavelet filter (11) of the said digital video signals performing a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signals, in order to obtain a succession of mosaic encoded digital signals encoding the said signals in the form of a succession of picture mosaics,

- an encoding assembly for producing a flow of binary signals from the succession of mosaic encoded digital signals,

- a compression assembly (13/CP) for compressing the flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals, and

• whereas this compression and decompression device comprises for the decompression:

- a decompression assembly (13/DP) for decompressing the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression assembly, of the majority of binary signals of determined value,

- a decoding assembly producing a succession of mosaic encoded digital

signals,

- a final decoding assembly composed of a reverse-operating wavelet filter, which reconstructs, from wavelets representing in the form of picture mosaics, a digital video signals, the said digital video signals,

characterised in that

• for the compression, it comprises, moreover, at least as regards the luminance component in the said input digital video signals, an additional encoding assembly (12 A), whose input (20) is connected to the output (16) of the said wavelet filter (11) and whose output (24) is connected to the input (25) of the said compression assembly (13/CP), whereas this assembly is sensitive to the displacements of the contours in the said successive pictures represented by the said succession of encoded signals with mosaic pictures received at the input and comprising, in order to process each pixel of a frame,

a) means (21) to deduct from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any, said means being:

- means (21*a*) for a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signals *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signals *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- means (21*b*) for a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which

simultaneously the said first signals *DP* exhibits the said first value representing the overrun of the said threshold and the said second signals *CO* varies significantly between neighbouring pixels, where as both these processes, time-related and space-related, and

- means (21*c*) to deduct, from the said moving pixels, on the one hand, the first value, representative of a displacement, for the said second binary signals and, on the other, the digital values of said both other digital groups among the said four groups of digital signals,

b) means (34) to restore the position of the pixel if it has been displaced,

c) means (39) to check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,

d) means to memorise the result of this check, and

e) means (40) to transfer to the said compression assembly (13/CP) either the said packet of signals representative in case of compliance, or the picture mosaic encoded signals from the said wavelet filter in case of non-compliance; and,

• for the decompression, it comprises, moreover, a preliminary decoding assembly, whose input is connected to the output of the said decompression assembly and whose output is connected to the reverse input of the said wavelet filter, which comprises:

a) a loop (50-51-52) whose input (34c) receives, from the said decompression assembly (13/DP), the said reconstructed flow of binary signals, which starts with a picture mosaic type signals corresponding to a first frame of the video signals to be reconstructed and which circulates in the form of a picture mosaic type signals, whereas the travel duration of the said signals over the said loop is equal to that of a frame of the video signals to be reconstructed,

b) means (70) to reposition, in the said loop, the pixels having undergone a displacement indicated by a group of digital signals which represent, in the said reconstructed flow of digital signals, the amplitude and the displacement

direction,

c) means (203) to replace the picture mosaic type signals in circulation in the loop with the new signals of this type as they arrive, and

d) means to transmit to the final decoding operation, from an output (35) located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning.

8. A device according to claim 7, characterised in that, for the decompression, the said preliminary decoding assembly comprises:

- means to cause to circulate normally, in a loop (50-51-52), a frame of the said decompressed signals, but encoded, received from the said decompression portion of the said compression-decompression assembly as long as both binary signals represent simultaneously an absence of correction and an absence of movement,
- means to replace, in the said loop, the frame in circulation, with a new frame arriving with new pixel values, in case when the binary correction signals indicates the necessity of a correction,
- means to perform, in a square matrix (50), whose odd number of lines and of columns is smaller than the number of lines and of columns of a frame, whereas both these numbers are greater than, by at least one unit, the number of quantification levels of the said displacement amplitude, and through which circulate the said decompressed signals, a translation operation of the moving pixels within the said matrix from their position to the centre position of pixel in the said matrix, in case when the said first binary correction signals indicates an absence of correction while the said second binary displacement signals indicates a displacement.

9. A device according to claim 7 or 8, characterised it comprises means (203) to cause the said digital signal encoded at the input to circulate over a loop (50-51-52), whose travel duration needed by the said signal is equal to the duration of a frame of this signal, means to cause the said signal, during its travel over the said loop, to pass through a pixel position matrix (50) the

number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signal is injected into the said loop at a central position (60) of the said matrix (50), means (70) to bring back, after running the said first frame of each sequence, within the said central position (60) a pixel of the said signal, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the packet of correction bits regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and means to extract from the said loop, in a position (35) located downstream, in the running direction, of the said central position (60), the successive frames thus restored.

10. A video compression apparatus, comprising:

- a motion analysis stage, comprising circuitry and/or software designed to identify a pixel of a current frame of a video whose contents correspond to a different pixel of a previous frame of the video, and designed to produce a datum coding motion between the pixel of the previous frame and the pixel of the current frame; and
- at least one other video processing stage of circuitry and/or software interconnected with the motion analysis stage to effect compression of the video.

11. The apparatus of claim 10, wherein the motion analysis stage further comprises circuitry and/or software designed to identify a pixel of the current frame whose contents corresponds to the same pixel of the previous frame.

12. The apparatus of claim 11, wherein the corresponding content is identified when a numerical value of the pixel of the current frame differs from the pixel of the previous frame within a threshold tolerance.

13. The apparatus of claim 11, wherein a datum coding the pixel of the current frame whose contents corresponds to the same pixel of the previous frame is entirely zeros.

14. The apparatus of claim 10, wherein the motion analysis stage further comprises circuitry and/or software designed to convey a content of one pixel of the current frame instead of the datum coding motion of the one pixel.

15. The apparatus of claim 14, wherein the one pixel is selected because of a large change in the content of the one pixel.

16. The apparatus of claim 10, wherein the motion is encoded as a spatial displacement between the pixel of the previous frame and the pixel of the current frame.

17. The apparatus of claim 16, wherein the spatial displacement is encoded as a direction and distance.

18. The apparatus of claim 10, further comprising:

a decoder designed to decode motion coding data produced by the motion analysis stage;

a comparator designed to compare the decoded motion generated by the decoder to a representation of input to the motion analysis stage; and

circuitry and/or hardware controlled by the comparator.

19. The apparatus of claim 18, wherein the circuitry controlled by the comparator introduces corrections in a representation of the stored motion stored in the decoder.

20. The apparatus of claim 18, wherein the circuitry controlled by the comparator is designed to increase a compression factor of the apparatus by introducing noise into the compression of the video.

21. The apparatus of claim 18, wherein the circuitry controlled by the comparator suppresses a motion coding datum, and replaces it with a less-encoded datum for a corresponding portion of the video.

22. The apparatus of claim 10, further comprising:

a wavelet coder upstream of the motion analysis stage.

23. The apparatus of claim 10 or 22, further comprising a run-length coder downstream of the motion analysis stage.

24. The apparatus of claim 10, wherein the motion analysis stage analyses a luminance channel of the video.

25. The apparatus of claim 24, wherein chrominance channels of the video are not analysed in the motion analysis stage.

26. The apparatus of claim 24, wherein chrominance channels of the video are compressed based on the analysis of the luminance channel.

27. The apparatus of claim 24, wherein chrominance channels of the video are compressed according to an intensity change during the stage that analyses the luminance channel.

28. Apparatus for processing digitally encoded video, comprising:

one sequential buffer memory of the size of at least one frame plus 2n lines 2n+1 pixels, where n is the maximum amplitude of motion, digitally encodable in the video pixels, in said buffer memory, said memory having only one operational entry port and one operational output port;

means for delivering to said buffer memory, in a sequential mode on said single entry port, successive pixel values of successive frames of said digitally encoded video; and

circuit and/or software for replacing pixel values in a current video frame at least partially stored, in a sequential mode, in said buffer memory, with pixel values from a previous frame at least partially stored, in a sequential mode, in said buffer memory, in compliance with digital control data, representative of the pixel motion, encoded in said buffer memory.

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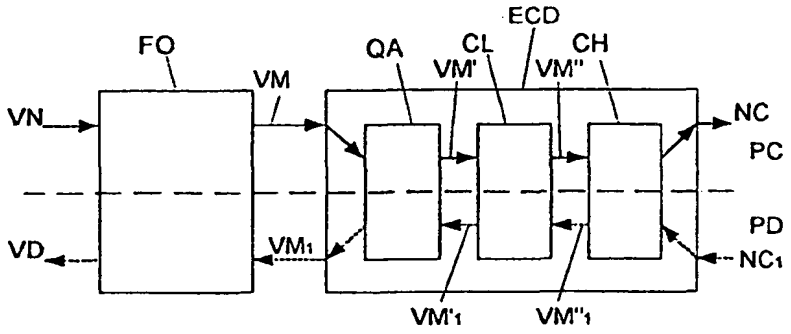

(57) Abstract

For the compression, preferably between a preliminary encoding, such as an encoding by a wavelet filter (11) and a compression in a compression–decompression assembly (13), as used in the system MPEG, there is a displacement encoding GVPP stage (12A) which generates, at the beginning of each sequence a frame of the video signal received and then, for each pixel, correction digital signals indicating a displacement for this pixel, with the quantified amplitude and oriented direction of the displacement, or a non–displacement, until global modification of the pixels marking the beginning of a new sequence and, for the decompression, preferably between a decompression in a compression–decompression assembly (13), of the type mentioned above, and a final decoding, such as performed in a reverse–operating wavelet filter (11), a displacement decoding assembly (12B), which, from a signal compressed by the compression mentioned above, transmits the frames of the beginning of each sequence and then replaces in position the pixels whose displacement is indicated by correction signals, while leaving in position the other pixels.

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CLAIMS

1. A process for compressing a digital video signal and for decompressing a compressed digital signal resulting from such a compression, characterised in that it comprises

- as regards the compression, an encoding operation consisting in looking for the displacements and the sudden modifications in the different corresponding pixels, between two successive frames of a digital signal to be encoded at the input, representative of a succession of corresponding frames of the said video signal, each composed of a succession of pixels and consisting in deducting from the said displacements and from the said sudden modifications, an encoded output signal which comprises, for the initial sequence and for each following sequence of the digital signal beginning with a modification in the video picture represented by the said digital video signal, in a given frame with respect to the previous frame,

on the one hand, at the beginning of sequence, as well as for the pixels suddenly modified in value, at least the said frame or the said pixels of the said digital signal to be encoded at the input, without any modification, and

on the other hand, throughout the sequence up to the beginning of the following sequence, a succession of correction bit packets, representative for each pixel of a frame, of the existence, respectively of the non-existence, of a displacement of the said pixel between the frame involved and the previous frame, and in the former case of the quantified amplitude and of the quantified oriented direction of the displacement; and

- as regards the decompression, a decoding operation consisting in decoding a digital signal to be decoded at the input, composed of an encoded signal resulting from the said encoding operation, i.e. comprising for each sequence at least a first digital signal frame, not modified by the said encoding operation, followed by a succession of correction bit packets, with non-modified pixels, into an output decoded signal, in which the succession of corresponding

frames of the digital signal before encoding in the said encoding operation has been restored and which consists of the said first digital signal frame followed by a succession of frames deducted from the said first frame by restoring the position of the pixels having been displaced, in relation to the packet of corresponding correction bits.

2. A process according to claim 1, characterised in that the said encoding operation consists, as regards the search for displacements and sudden modifications of the pixels, in subjecting the said digital signal to be encoded at the input, one frame at a time,

- to a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,
- to a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels,
- to a process for deducting, for the said moving pixels, the amplitude and the oriented direction of the displacement,
- to a process for reconstructing the said input signal by restoring the position of the pixels having been displaced, and
- to a comparison process between the said digital signal to be encoded

at the input and the said reconstructed signal in order to determine any modifications.

3. A process according to claim 1, characterised in the said decoding operation consists in causing the said digital signal encoded at the input to circulate over a loop whose travel duration needed by the said signal is equal to the duration of a frame of this signal, in causing the said signal, during its travel over the said loop, to pass through a pixel position matrix the number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signal is injected into the said loop at a central position of the said matrix, in bringing back, after running the said first frame of each sequence, within the said central position, a pixel of the said signal, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the packet of correction bits regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and in extracting from the said loop, in a position located downstream, in the running direction, of the said central position, the successive frames thus restored.

4. A process according to claim 1 or 2 characterised in that the said encoding operation takes place between a preliminary encoding operation, composed of a wavelet analysis which encodes an input digital video signal into a digital signal with successive picture mosaics, which makes up the input signal for the said encoding operation, and a compression operation of a flow of binary signals in order to reduce the number of the binary signals in the said output signal of the said encoding operation, by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals.

5. A process according to claim 1 or 3 characterised in that the said decoding operation should take place between a decompression operation of

compressed binary signals which reconstructs the flow of corresponding binary signals before suppression, in the said compression operation, of the majority of binary signals of determined value, and a final decoding operation, reverse of a wavelet filter, which reconstructs, from a succession of picture mosaic type signals, a digital video signal formed by a succession of frames, each made of a succession of pixels.

6. A device for compressing a digital video signal and for decompressing a compressed digital signal resulting from a compression, characterised in that it comprises

- as regards the compression, an encoding assembly (12A) comprising means to look for the displacements and the sudden modifications in the different corresponding pixels, between two successive frames of a digital signal to be encoded at the input, representative of a succession of corresponding frames of the said video signal, each composed of a succession of pixels and to deduct from the said displacements and from the said sudden modifications, an encoded output signal which comprises, for the initial sequence and for each following sequence of the digital signal beginning with a modification in the video picture represented by the said digital video signal, in a given frame with respect to the previous frame,

on the one hand, at the beginning of sequence, as well as for the pixels suddenly modified in value, at least the said frame or the said pixels of the said digital signal to be encoded at the input, without any modification, and

on the other hand, throughout the sequence up to the beginning of the following sequence, a succession of correction bit packets, representative for each pixel of a frame, of the existence, respectively of the non-existence, of a displacement of the said pixel between the frame involved and the previous frame, and in the former case of the quantified amplitude and of the quantified oriented direction of the displacement; and

- as regards the decompression, a decoding assembly (12B) consisting in decoding a digital signal to be decoded at the input, composed of an encoded

signal resulting from the said encoding operation, i.e. comprising for each sequence at least a first digital signal frame, not modified by the said encoding operation, followed by a succession of correction bit packets, with non-modified pixels, into an output decoded signal, in which the succession of corresponding frames of the digital signal before encoding in the said encoding operation has been restored and which consists of the said first digital signal frame followed by a succession of frames deducted from the said first frame by restoring the position of the pixels having been displaced, in relation to the packet of corresponding correction bits.

7. A device according to claim 6, characterised in that the said encoding assembly (12A), which receives, at its input, the said digital signal to be encoded at the input, comprises in order to process the said signal, one frame at a time, and to look for the sudden displacements and modifications of the pixels:

means (21*a*) to subject the said signal to a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

means (21*b*) to perform a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels,

means (12c) to deduct, for the said moving pixels, the amplitude and the oriented direction of the displacement,

means (34) to reconstruct the said input signal by restoring the position of the pixels having moved, and

means (39) to compare the said digital signal to be encoded at the input with the said reconstructed signal in order to determine the modifications.

8. A device according to claim 6, characterised in that the said decoding assembly (12B) comprises means (203) to cause the said digital signal encoded at the input to circulate over a loop (50-51-52), whose travel duration needed by the said signal is equal to the duration of a frame of this signal, means to cause the said signal, during its travel over the said loop, to pass through a pixel position matrix (50) the number of whose rows, on the one hand, and the number of whose columns, on the other, is at least equal to 2n+1, while designating by *n* the number of levels quantifying the displacement amplitude, whereby the said signal is injected into the said loop at a central position (60) of the said matrix (50), means (70) to bring back, after running the said first frame of each sequence, within the said central position (60) a pixel of the said signal, while moving inside the said matrix, which has moved between the frame involved and the previous frame, in relation to the packet of correction bits regarding the said pixel, in order thus to restore the successive frames of the sequences as they were before encoding in the encoding operation, and means to extract from the said loop, in a position (35) located downstream, in the running direction, of the said central position (60), the successive frames thus restored.

9. A device according to claim 6 or 7, characterised in that the said encoding assembly is arranged between a preliminary encoding assembly, composed of a wavelet filter (11), which encodes an input digital video signal into a digital signal with successive picture mosaics, which makes up the input signal for the said encoding operation, and an assembly (13) for compressing a flow of binary signals in order to reduce the number of the binary signals in the

said output signal of the said encoding operation, by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals.

10. A device according to claim 6 or 8, characterised in that the said decoding assembly is arranged between an assembly (13) for decompressing compressed binary signals which reconstructs the flow of corresponding binary signals before suppression, in the said compression assembly, of the majority of binary signals of determined value, and a decoding assembly, composed of a reverse-operating wavelet filter (11), which reconstructs, from wavelets representing in the form of picture mosaics, a digital video signal, the said digital video signal.

11. A process for compressing a digital video signal formed by a succession of corresponding frames, each composed of a succession of pixels,

which comprises a preliminary encoding operation of the said video signal using a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signal, in order to obtain a succession of encoded digital signals encoding the said signal in the form of a succession of picture mosaics, and a compression operation of a flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals, and

which is characterised in that it comprises, besides, at least as regards the luminance component in the said video signal, an additional encoding operation, applied to the succession of encoded digital signals with picture mosaics resulting from the said preliminary encoding operation, which is sensitive to the displacements of the contours in the said successive pictures and which consists, for each pixel in a frame,

- in deducting from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the frame involved and the

previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any,

- in restoring the position of the pixel if it has been displaced,
- in checking whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,
- in memorising the result of this check, and
- in transferring to the said compression operation, either the said packet of signals representative in case of compliance or the picture mosaic encoded signal from the said preliminary encoding operation in case of non-compliance.

12. A device for compressing a digital video signal formed by a succession of corresponding frames, each composed of a succession of pixels,

which comprises at least one wavelet filter (11) for preliminary encoding of the said digital video signal performing a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signal, in order to obtain a succession of encoded digital signals encoding the said signal in the form of a succession of picture mosaics, and an assembly (13) for compressing a flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals, and

which is characterised in that it comprises, besides, at least as regards the luminance component in the said video signal, an additional encoding assembly (12A), whose input (20) is connected to the output (16) of the said wavelet filter (11) and whose output (24) is connected to the input of the said compression assembly, whereas this assembly is sensitive to the displacements of the contours in the said successive pictures represented by the said succession of encoded signals with mosaic pictures received at the input and comprising, in order to process each pixel of a frame,

- means (21) to deduct from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any,
- means (34) to restore the position of the pixel if it has been displaced,
- means (39) to check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,
- means (34a) to memorise the result of this check, and
- means (40) to transfer to the said compression assembly, either the said packet of signals representative in case of compliance or the picture mosaic encoded signal from the said wavelet filter in case of non-compliance.

13. A process for decompressing a flow of compressed binary signals resulting from the implementation of the compression process of claim 11, in order to reconstruct more or less the compressed digital video signal formed by a succession of corresponding frames, each composed of a succession of pixels,

which comprises a decompression operation of the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression operation, of the majority of binary signals of determined value, and a final decoding operation reconstructing, from a succession of picture mosaic type signals, a digital video signal formed by a succession of frames, each made of a succession of pixels, and

which is characterised in that it comprises moreover a preliminary encoding operation, which is applied to the said reconstructed flow of decompressed binary signals and which, from the said flow of decompressed binary signals received

- causes to circulate over a loop, from an input position on this loop, a

signal, of the said flow, of the picture mosaic type corresponding to a first frame of the video signal to be reconstructed and resulting from the said decompression operation,

- repositions in the said loop, the pixels having undergone a displacement signalled by a group of digital signals representing, in the said reconstructed flow of binary signals, the amplitude and the oriented direction of the displacement, also resulting from the said decompression operation,
- replaces the picture mosaic type signals in circulation over the said loop with the new signals of this type as they arrive,
- transmits to the final decoding operation, from an output position on this loop located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning.

14. A device for decompressing a flow of compressed binary signals resulting from the implementation of the compression device of claim 12, in order to reconstruct more or less the compressed digital video signal formed by a succession of corresponding frames, each composed of a succession of pixels,

which comprises an assembly (13/DP) for decompressing the said compressed binary signals which reconstruct the said flow of binary signals before suppression, in the said compression assembly (13/CP), of the majority of binary signals of determined value, and a decoding assembly, made of a reverse-operating wavelet filter (11), reconstructing, from wavelets representing in the form of picture mosaic type signals, a digital video signal, the said digital video signal, and

which is characterised in that it comprises, moreover, a preliminary decoding assembly (12B), whose input (36') is connected to the output (36) of the said decompression assembly and whose output (17') is connected to the reverse input (17) of the said wavelet filter, which comprises

- a loop (50-51-52) whose input (34c) receives, from the said

decompression assembly, the said reconstructed flow of binary signals, which starts with a picture mosaic type signal corresponding to a first frame of the video signal to be reconstructed and which circulates in the form of a picture mosaic type signal, whereas the travel duration of the said signal over the said loop is equal to that of a frame of the video signal to be reconstructed,

- means to reposition, in the said loop, the pixels having undergone a displacement indicated by a group of digital signals which represent, in the said reconstructed flow of digital signals, the amplitude and the displacement direction,
- means to replace the picture mosaic type signals in circulation in the loop with the new signals of this type as they arrive, and
- means to transmit to the final decoding operation, from an output (35) located downstream of the said input (34c), the picture mosaic type signals circulating in the loop, after possible repositioning

15. An additional encoding process for digital data resulting from a preliminary encoding operation which performs a wavelet analysis of at least the luminance component of a digital video signal representative of a succession of corresponding frames, each composed of a succession of pixels, while favouring the transmission of the contours in the said succession of frames, in order to obtain a succession of encoded digital signals representative of picture mosaic composite frames, whereas the said process, which is sensitive to the displacements of the said contours in the said succession of composite frames and enables further compression of a flow of binary signals in a later compression operation reducing the number of binary signals by deleting the majority of binary signals, in the said flow, with a value determined between both possible values of such signals, characterised in that it consists, for each pixel of a frame,

- in deducting from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or

of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any,

- in restoring the position of the pixel if it has been displaced,
- in checking whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,
- in memorising the result of this check, and
- in transferring to the said compression operation, either the said packet of signals representative in case of compliance or the picture mosaic encoded signal from the said preliminary encoding operation in case of non-compliance.

16. An additional encoding process according to claim 15, characterised in that the said packet of binary signals from the said succession of picture mosaic encoded signals while performing, one frame at a time,

- a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,
- a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second

signal CO varies significantly between neighbouring pixels, and

- a process for deducting, for the said moving pixels, the amplitude and the oriented direction of the displacement.

17. A preliminary decoding process for digital data capable of processing a flow of binary signals from a data decompression operation consisting in reconstructing, from the flow of compressed binary signals resulting from the implementation of the compression process of claim 11, the flow of binary signals before suppression, in the compression operation mentioned above, of the majority of binary signals having a determined digital value, and capable of providing, to a final decoding operation restoring, from a succession of picture mosaic signals, a digital video signal formed by a succession of frames, each composed of a succession of pixels, characterised in that, from the flow of decompressed binary signals received, it consists

- in causing to circulate over a loop, from an input position on this loop, a signal, of the said flow, of the picture mosaic type corresponding to a first frame of the video signal to be reconstructed and resulting from the said decompression operation, whereas the travel duration of the said flow over the said loop is equal to the frame duration of the video signal to be reconstructed
- in repositioning in the said loop, the pixels having undergone a displacement indicated by a group of digital signals representing, in the said reconstructed flow of binary signals, the amplitude and the oriented direction of the displacement,
- in replacing the picture mosaic type signals in circulation over the said loop with the new signals of this type as they arrive, and
- in transmitting to the final decoding operation, from an output position on this loop located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning

18. A process according to any of the claims 1, 2, 3, 4, 5, 7, 11, 13, 15 and 17, characterised in that the said packet of correction digital signals

implemented, for each pixel, in the operations and the compression and decompression assemblies according to the invention, comprises four groups of signals, whereas the first consists of a single binary signal whereby one of both possible values of which represents a global modification of the pictures between a frame and the previous frame and the other value a global non-modification, whereas the second also consists of a single binary signal whereby one of both possible values of which represents a displacement for the pixel and the other value a non-displacement and whose both other groups consist of digital signals with a limited number of bits and represent, one the quantified amplitude and the other the quantified oriented direction of the displacement if any

19. A process according to claim 18, characterised in that

- the said additional encoding operation comprises the determination, for each pixel of a frame, of a packet of four groups of signals of the type mentioned above on the one hand, while comparing the value of the pixel in the frame being processed and in the previous frames in order to determine whether there is a displacement, hence the first value for the binary signal of the said second group, or non-displacement, hence the second value for this binary signal, and to determine, in case of displacement, the quantified amplitude and the quantified oriented direction of the displacement, hence the value of the signals in the said other groups, whereas both signals have a zero value in case of non-displacement of the pixel and, on the other hand, while comparing the values of a pixel at a predetermined position in a frame with that of a pixel in the same position in the frame just preceding and while checking whether the difference between both these values, in absolute value, exceeds or not a predetermined threshold, which determines the value, between both possible values, of the binary signal of the said first group:
- whereas the said preliminary decoding operation consists
  - in causing initially a decompressed digital signal to circulate in the said loop, a succession of picture mosaic signals arriving at

the input and representing a frame of the digital video signal to be reconstructed, when it arrives, and this without any modification up to the arrival of a subsequent packet of four groups of digital signals of the type mentioned above which indicate a displacement for a portion of the pixels,

- in restoring, in the loop-circulating frame, the position of the pixels for which a displacement is indicated by the value of the signal of the said second group, whereas this position restoration is determined by the values of said both other groups of binary signals of the said packet specifying the amplitude and the oriented direction of the displacement, and this, up to the arrival of a new frame of digital picture mosaic signals,
- in recommencing on this new frame the successive operation of loop-circulation and position restoration of the pixels having been displaced, and
- in extracting, downstream of the input, in order to transfer them to the said final decoding operation, the signals circulating in the said loop, which are composed, downstream of this input, exclusively of picture mosaic signals.

20. A process according to claim 19, characterised in that the said preliminary decoding operation comprises in the said loop a square matrix whose odd number of lines and whose number of columns are respectively smaller than the number of lines and the number of columns of a frame of the video signals to be reconstructed, whereas both these numbers are greater, at least by one unit, than the number of quantification levels of the said displacement amplitude, and through which circulate the signals from the said decompression operation, and the position of the pixels having been displaced is restored, whereas they are subject in the said matrix to a reverse direction translation whose quantified amplitude and whose quantified oriented direction are specified by the digital values of said both other groups of signals.

21. An additional encoding device of digital data, generated at the output by a preliminary encoding wavelet filter (11) receiving at its input (20) at least the luminance component of a digital video signal representative of a succession of corresponding frames, each composed of a succession of pixels, while favouring the transmission of the contours in the said succession of frames, in order to obtain a succession of encoded digital signals representative of picture mosaic composite frames, whereas the said process, which is sensitive to the displacements of the said contours in the said succession of composite frames and enables further compression of a flow of binary signals in a later compression assembly (13) reducing the number of binary signals by deleting the majority of binary signals, in the said flow, with a value determined between both possible values of such signals, characterised in that it comprises as a combination:

a) means (21) to encode the said digital signals, one pixel at a time, in relation to the value variation of each pixel between the frame processed and the previous frames by implementing for each pixel, a block of four digital signals among which

- the first one, which is a binary signal, represents, by both its possible values, either the necessity of global correction or the non-necessity of such a correction,
- the second one, who is also a binary signal, appears exclusively when the said first signal represents the non-necessity of global correction and it then represents, by both its possible values, either a displacement or a non-displacement, and
- the other two, which are both digital signals with a limited number of bits, appear exclusively when the said first signal represents the non-necessity of correction and they then represent, one the quantified amplitude and the other the quantified oriented direction of the displacement in a zone of the composite frame involved;

b) means (CP) to determine whether the proportion, in each successive frame, of the number of pixels for which the said first binary signal has the value representative of a correction necessity with respect to the total number of pixels in the frame, exceeds a determined percentage; and

c) means (40) to transmit, one frame after the other, to the said final compression assembly

- if the said percentage is not exceeded: the said block of four signals related to the pixel affected,
- if the said percentage is exceeded: the encoded digital signal generated by the said wavelet filter related to the pixel affected in a previous frame.

22. An additional encoding device according to claim 21, characterised in that the said means (21) to encode the said digital signals comprise

- means (21*a*) for a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,
- means (21*b*) for a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels, and

- means (21*c*) to deduct, for the said moving pixels, on the one hand, the first value, representative of a displacement, for the said second binary signal and, on the other, the digital values of said both other digital groups among the said four groups of digital signals, in case of displacement.

23. A preliminary decoding device for digital data capable of processing a flow of binary signals, received at the input (36') from a data decompression assembly (13) and resulting from the decompression of signals having undergone a compression in a device according to claim 21 or 22, by suppression of the majority of binary signals having a determined digital value, in order to generate at the output (17'), for processing in a reverse-operating wavelet filter (11), a digital video signal formed by a succession of frames, constituted and characterised in that it comprises, in order to process the flow of digital signals received at the input from the said decompression assembly, a displacement decoding assembly (12b) capable of reconstructing, at the decoding input (17) of the said reverse-operating wavelet filter, a succession of displacement-decoded signals, but encoded into composite frames.

24. A device according to claim 23, characterised in that the said displacement decoding assembly (12B) comprises as a combination:

- means (50-51-52) to cause to circulate normally, in a loop, a frame of the digital signals representative of a frame of picture mosaic composite signals making up the beginning of a shot, arriving at the input, so long as both binary signals represent simultaneously an absence of correction and an absence of movement, whereas the travel duration of the said loop is equal to the duration of a frame,
- means (203) for replacing, in the said loop, at least one pixel of this frame in circulation, with a new pixel value, in case when the said second binary correction signal indicates the necessity of a correction, for the said at least one pixel, whereas this new value results from repositioning the pixel having undergone a displacement whose

quantified amplitude and whose quantified oriented direction are specified by said both other signals of the said packet of four signals,

- means to perform, in a square matrix (50), whose odd number of lines and of columns is smaller than the number of lines and of columns of a frame, whereas both these numbers are greater than, by at least one unit, the number of quantification levels of the said displacement amplitude, and through which circulate the said picture mosaic composite signals, in case when the said first binary correction signal indicates an absence of correction while the said second binary displacement signal indicates a displacement, a translation operation of the moving pixels within the said matrix from their positions to the central pixel position (60) inside the said matrix, and
- means (at 35) to extract the signals circulating in the said loop, downstream of the input (at 34c) into the said loop, and which consist of picture mosaic type signals.

25. An integrated data compression process characterised in that it comprises successively a wavelet analysis operation performing a preliminary encoding, a displacement encoding operation by the additional encoding process according to claim 15 or 16 and a final compression operation.

26 An integrated data compression device characterised in that it comprises the additional encoding device according to claim 21 or 22 between a wavelet filter (11) and a final compression assembly (13).

27. An integrated data decompression process characterised in that it comprises an initial decompression process, a preliminary displacement decoding operation according to the process of claim 19 or 20 and a reverse-operating wavelet analysis operation.

28. An integrated data decompression device characterised in that it comprises the additional decompression device according to claim 23 or 24 between an initial decompression assembly (13) and a reverse-operating wavelet filter (11).

29. A process for compressing a digital video signal formed by a succession of corresponding frames, each formed by a succession of pixels as well as for decompressing digital signals compressed by such a compression process, whereas this compression and decompression process comprises:

- as regards the compression, a preliminary encoding operation of the said video signal using a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signal, in order to obtain a succession of encoded digital signals encoding the said signal in the form of a succession of picture mosaics, and a compression operation of a flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals, and
- as regards the decompression, a decompression operation of the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression operation, of the majority of binary signals of determined value, and a final decoding operation reconstructing, from a succession of picture mosaic type signals, a digital video signal formed by a succession of frames, each made of a succession of pixels, and

which is characterised in that

- for the compression, it comprises, moreover, at least as regards the luminance component in the said video signal, an additional encoding operation, applied to the succession of picture mosaic encoded digital signals resulting from the said preliminary encoding operation, which is sensitive to the displacements of the contours in the said successive pictures and which consists, for each pixel of a frame,
  - in deducting from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the

frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any,

- in restoring the position of the pixel if it has been displaced,
- in checking whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,
- in memorising the result of this check, and
- in transferring to the said compression assembly, either the said packet of signals representative in case of compliance or the picture mosaic encoded signal from the said wavelet filter in case of non-compliance;

- and for the decompression, it comprises, moreover, a preliminary decoding operation, which is applied to the said reconstructed flow of decompressed binary signals and which, from the said flow of decompressed binary signals received

- causes initially to circulate over a loop, from an input position on this loop, a signal, of the said flow, of the picture mosaic type corresponding to a first frame of the video signal to be reconstructed and resulting from the said decompression operation,
- repositions in the said loop, the pixels having undergone a displacement signalled by a group of digital signals representing, in the said reconstructed flow of binary signals, the amplitude and the oriented direction of the displacement, also resulting from the said decompression operation,
- replaces the picture mosaic type signals in circulation over the said loop with the new signals of this type as they arrive,

- transmits to the final decoding operation, from an output position on this loop located downstream of the said input position, the picture mosaic type signals circulating in the loop,

after possible repositioning.

30. A process according to claim 29, characterised in that it comprises, for the compression

- the preliminary encoding of the succession of the digital video signals to be compressed into a succession of encoded digital signals corresponding to the scanning, in each frame, of the Mallat diagram and making up the picture mosaic, using a wavelet filter;
- the final compression, using a compression-decompression assembly, with an adaptive quantifier, *RCL* type encoder and *CH* encoder, Huffman encoder type, operating in compression.

31. A process according to claim 29, characterised in that it comprises, for the decompression,

- the decompression, using the said compression-decompression assembly, operating in decompression,
- the decoding, using the said reverse-operating wavelet filter.

32. A process according to claim 29 or 30, characterised in that the compression includes the preliminary encoding operation of the succession of encoded digital signals resulting from the scanning of a picture mosaic composite frame while performing in sequence for this succession, for each frame one after the other,

- a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun determined by the said variation and a second value the non-overrun of this

threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels, and
- to deduct for the said moving pixels, on the one hand, the first value, representative of a displacement, for the said second binary signal and, on the other, the digital values of said both other digital groups among the said four groups of digital signals

33. A process according to claim 29 or 31, characterised in that, the decompression includes the final decompression of the succession of digital signals from the initial decompression operation, in order to obtain a succession of digital signals corresponding to the scanning of a picture mosaic composite frame by a process consisting

- in causing to circulate normally, in a loop, a frame of the said digital signals from the initial decompression operation, as long as both binary signals represent simultaneously an absence of correction and an absence of movement,
- in replacing, in the said loop, the frame in circulation, with a new frame arriving from the said initial decompression operation, in case when the binary correction signal indicates the necessity of a correction,
- in performing, in a square matrix, whose odd number of lines and of columns is smaller than the number of lines and of columns of a frame, whereas both these numbers are greater than, by at least one unit, the number of quantification levels of the said

displacement amplitude, and through which circulate the said picture mosaic composite signals, in case when the said first binary correction signal indicates an absence of correction while the said second binary displacement signal indicates a displacement, a translation operation of the moving pixels within the said matrix from their positions to the central pixel position inside the said matrix, and

- in performing an extraction of the signals circulating in the said loop downstream of the input of the signals from the said initial decompression operation.

34. A device for compressing a digital video signal formed by a succession of corresponding frames, each formed by a succession of pixels, as well as for decompressing compressed digital signals in a device of this type, operating in compression, whereas this compression and decompression device comprises:

- for the compression, at least one preliminary encoding wavelet filter (11) of the said digital video signal performing a wavelet analysis, favouring the transmission of the contours of the successive pictures represented by the said signal, in order to obtain a succession of encoded digital signals encoding the said signal in the form of a succession of picture mosaics, and an assembly (13/CP) for compressing a flow of binary signals in order to reduce the number of the binary signals by suppression of the majority of the binary signals of the said flow whose value is determined within both possible values of such signals,
- and, for the decompression, an assembly (13/DP) for decompressing the said compressed binary signals which reconstructs the said flow of binary signals before suppression, in the said compression assembly, of the majority of binary signals of determined value, and a decoding assembly, composed of a reverse-operating wavelet filter, which reconstructs, from wavelets representing in the form of picture mosaics,

a digital video signal, the said digital video signal,
and characterised in that

- for the compression, it comprises, moreover, at least as regards the luminance component in the said video signal, an additional encoding assembly (12 A), whose input (20) is connected to the output (16) of the said wavelet filter (11) and whose output (24) is connected to the input (25) of the said compression assembly (13/CP), whereas this assembly is sensitive to the displacements of the contours in the said successive pictures represented by the said succession of encoded signals with mosaic pictures received at the input and comprising, in order to process each pixel of a frame,
  - means (21) to deduct from the said succession of encoded signals with picture mosaics, a packet of binary signals representative of a displacement or of a non-displacement of the pixel between the frame involved and the previous frames, as well as of the amplitude and of the oriented direction of the displacement, if any,
  - means (34) to restore the position of the pixel if it has been displaced,
  - means (39) to check whether the position-restored pixel in case of displacement is in compliance or in non-compliance with the corresponding pixel of the frame involved,
  - means to memorise the result of this check, and
  - means (40) to transfer to the said compression assembly (13/CP) either the said packet of signals representative in case of compliance or the picture mosaic encoded signal from the said wavelet filter in case of non-compliance;
- and, for the decompression, it comprises, moreover, a preliminary decoding assembly, whose input is connected to the output of the said decompression assembly and whose output is connected to the reverse

input of the said wavelet filter, which comprises

- a loop (50-51-52) whose input (34c) receives, from the said decompression assembly (13/DP), the said reconstructed flow of binary signals, which starts with a picture mosaic type signal corresponding to a first frame of the video signal to be reconstructed and which circulates in the form of a picture mosaic type signal, whereas the travel duration of the said signal over the said loop is equal to that of a frame of the video signal to be reconstructed,
- means (70) to reposition, in the said loop, the pixels having undergone a displacement indicated by a group of digital signals which represent, in the said reconstructed flow of digital signals, the amplitude and the displacement direction,
- means (203) to replace the picture mosaic type signals in circulation in the loop with the new signals of this type as they arrive, and
- means to transmit to the final decoding operation, from an output (35) located downstream of the said input position, the picture mosaic type signals circulating in the loop, after possible repositioning.

35. A device according to claim 34, characterised in that, for the compression, the said additional encoding assembly comprises:

- means (21*a*) for a time-related process, in which for each pixel, the value of the said pixel is compared with its previous correct value, smoothed using a «time constant» which is caused to evolve over the course of time to maximise the smoothing, in order to determine two parameters significant of the time variation of the pixel value, parameters which are variable over the course of time and represented by two digital signals, i.e. a first binary signal *DP*, a first value of which represents a threshold overrun

determined by the said variation and a second value the non-overrun of this threshold determined by the said variation, and a second digital signal *CO*, with a limited number of bits, representing the instant value, for the said pixel, of the said time constant,

- means (21*b*) for a space-related process of the values, for a given frame, of said both digital signals *DP* and *CO* to determine the moving pixels for which simultaneously the said first signal *DP* exhibits the said first value representing the overrun of the said threshold and the said second signal *CO* varies significantly between neighbouring pixels, where as both these processes, time-related and space-related, are realised as described in the patent applications, French and international, mentioned above, and
- means (21*c*) to deduct, from the said moving pixels, on the one hand, the first value, representative of a displacement, for the said second binary signal and, on the other, the digital values of said both other digital groups among the said four groups of digital signals.

36. A device according to claim 34, characterised in that, for the decompression, the said preliminary decoding assembly comprises:

- means to cause to circulate normally, in a loop (50-51-52), a frame of the said decompressed signals, but encoded, received from the said decompression portion of the said compression-decompression assembly as long as both binary signals represent simultaneously an absence of correction and an absence of movement,
- means to replace, in the said loop, the frame in circulation, with a new frame arriving with new pixel values, in case when the binary correction signal indicates the necessity of a correction,

- means to perform, in a square matrix (50), whose odd number of lines and of columns is smaller than the number of lines and of columns of a frame, whereas both these numbers are greater than, by at least one unit, the number of quantification levels of the said displacement amplitude, and through which circulate the said decompressed signals, a translation operation of the moving pixels within the said matrix from their position to the centre position of pixel in the said matrix, in case when the said first binary correction signal indicates an absence of correction while the said second binary displacement signal indicates a displacement.

37. A process according to any of the claims 1 to 5, 11, 15, 17, 18, 19, 25, 29, 30, characterised in that the additional encoding operation comprises the reconstruction, from the signal resulting from such an encoding, of the picture mosaic signal before this encoding having passed through the wavelet filter and the comparison of the reconstructed signal for a frame with the picture mosaic signal before this encoding for the frame just preceding.

38. A device according to any of the claims 6 to 10, 12, 14, 21, 22, 34, 35, characterised in that the additional encoding assembly comprises a unit (34) in order to reconstruct, from the signal having passed through the additional encoding, the picture mosaic signal before this encoding generated by the wavelet filter and to compare the reconstructed signal for a frame with the picture mosaic signal before this encoding for the frame just preceding.

39. An application of the comparison process according to claim 11 or of the compression device according to claim 12 to the recording on a recording medium, after compression, of a digital video signal.

40. An application of the decompression process according to claim 13 or of the decompression device according to claim 14 to the reading of a recording medium recorded by the application according to claim 39.

41. A picturephone system characterised in that it comprises in each set

a compression-decompression device according to claim 6 or 34.

42. A videoconference system characterised in that it comprises in each set a compression-decompression device according to claim 6 or 34.

43. A video compression apparatus, comprising:

a motion analysis stage, comprising circuitry and/or software designed to identify a region of a current frame of a video whose contents correspond to a different region of a previous frame of the video, and designed to produce a datum coding motion between the region of the previous frame and the region of the current frame; and

at least one other video processing stage of circuitry and/or software interconnected with the motion analysis stage to effect compression of the video.

44. The apparatus of claim 43, wherein the regions are single pixels.

45. The apparatus of claim 43, wherein the motion analysis stage further comprises circuitry and/or software designed to identify regions of the current frame whose contents corresponds to the same region of the previous frame.

46. The apparatus of claim 45, wherein the corresponding content is identified when a numerical value of the region of the current frame differs from the region of the previous frame within a threshold tolerance.

47. The apparatus of claim 45, wherein a datum coding the region of the current frame whose contents corresponds to the same region of the previous frame is entirely zeros.

48. The apparatus of claim 43, wherein the motion analysis stage further comprises circuitry and/or software designed to convey a content of one region of the current frame instead of the datum coding motion of the one region.

49. The apparatus of claim 48, wherein the one region is selected because of a large change in the content of the one region.

50. The apparatus of claim 43, wherein the motion is encoded as a

spatial displacement between the region of the previous frame and the region of the current frame.

51. The apparatus of claim 50, wherein the spatial displacement is encoded as a direction and distance.

52. The apparatus of claim 43, further comprising:

a decoder designed to decode motion coding data produced by the motion analysis stage;

a comparator designed to compare the decoded motion generated by the decoder to a representation of input to the motion analysis stage; and

circuitry and/or hardware controlled by the comparator.

53. The apparatus of claim 52, wherein the circuitry controlled by the comparator introduces corrections in a representation of the stored motion stored in the decoder.

54. The apparatus of claim 52, wherein the circuitry controlled by the comparator is designed to increase a compression factor of the apparatus by introducing noise into the compression of the video.

55. The apparatus of claim 52, wherein the circuitry controlled by the comparator suppresses a motion coding datum, and replaces it with a less-encoded datum for a corresponding portion of the video.

56. The apparatus of claim 43, further comprising:

a wavelet coder upstream of the motion analysis stage.

57. The apparatus of claim 43 or 56, further comprising a run-length coder downstream of the motion analysis stage.

58. The apparatus of claim 43, wherein the motion analysis stage analyses a luminance channel of the video.

59. The apparatus of claim 58, wherein chrominance channels of the video are not analysed in the motion analysis stage.

60. The apparatus of claim 58, wherein chrominance channels of the video are compressed based on the analysis of the luminance channel.

61. The apparatus of claim 58, wherein chrominance channels of the

video are compressed according to an intensity change during the stage that analyses the luminance channel.

62. An apparatus for processing digitally encoded video, comprising:

a buffer of size at least one frame plus 2n lines plus 2n+1 pixels, where n is a maximum amplitude of motion encodable in pixels in the buffer; and

circuitry and/or software designed replace pixel values in a current video frame at least partially stored in the buffer with pixel values from a previous frame at least partially stored in the buffer, according to motion encoded in the current contents of the buffer.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
822J PCT 389		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 99/06288	26/08/1999	28/08/1998
Applicant		
HOLDING B.E.V. SA et. al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [X] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [ ] as suggested by the applicant.

   [X] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/99/06288

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-61

A video compression process for which encoding consists in subjecting the input video signal, one frame at a time, to a time-related process that involves a smoothing operation using a time-constant that is caused to evolve over the course of time, relating to two numerical values (DP) and (CO), as well as to a space-related process to determine moving pixels for which the first numerical value (DP) overruns a threshold and the second numerical value (CO) varies significantly between neighbouring pixels.

2. Claim : 62

An apparatus for processing digitally encoded video, comprising a buffer size of at least one frame plus 2n lines plus 2n+1 pixels, where n is a maximum amplitude of motion encodable in pixels in the buffer.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP [redacted]6288

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/26 H04N7/50 H04N7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 712 449 A (KOKUSAI DENSHIN DENWA CO LTD) 19 May 1995 (1995-05-19) page 5, line 29 -page 12, line 26 figures 3,8	1,4-6,9, 10,23
A		2,3,7,8, 11-22, 24-61
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 April 2000	13. 04. 2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Fassnacht, C

4

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 679 032 A (OKI ELECTRIC IND CO LTD) 25 October 1995 (1995-10-25) the whole document	11-15, 17, 29-32, 39-43, 50,51
A		1,2,6,7, 16, 18-28, 33-38, 44-49, 52-62

X	US 5 495 292 A (ZAFAR SOHAIL ET AL) 27 February 1996 (1996-02-27) column 2, line 58 -column 7, line 47 figures 1,2	43,45, 50,52, 56,57

X	WO 96 14711 A (PICTURETEL CORP) 17 May 1996 (1996-05-17) page 21, line 10 -page 31, line 18 figures 6,12,13	43,58-61
A		1-42, 44-57

X	US 5 777 678 A (OGATA MASAMI ET AL) 7 July 1998 (1998-07-07) column 13, line 54 -column 16, line 40	43,56-61
A		1-42, 44-55

A	AD HOC GROUP ON MPEG-4 VIDEO VM EDITING: "APPENDIX A: COMBINED MOTION SHAPE TEXTURE CODING" MPEG-4 VIDEO VERIFICATION MODEL VERSION 7.0 - ISO/IEC JTC1/SC29/WG11 MPEG97/N1642, pages 195-203, XP002090865 the whole document	1-61

A	WO 95 20863 A (BRITISH TECH GROUP USA) 3 August 1995 (1995-08-03) page 77, line 22 -page 86, line 11 figures 53-60	1-61

A	MARTUCCI S A ET AL: "A ZEROTREE WAVELET VIDEO CODER" IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, vol. 7, no. 1, 1 February 1997 (1997-02-01), pages 109-118, XP000678884 the whole document	1-61

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INTERNATIONAL SEARCH REPORT

[redacted]ional Application No
PCT/EP [redacted]6288

C.(Continuation) DOCUMENTS CONSIDERED TO BE [redacted]EVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 543 197 A (GEN INSTRUMENT CORP) 26 May 1993 (1993-05-26) column 3, line 14 -column 4, line 6 column 9, line 36 -column 11, line 1 figures 8A-8C	62
A	-----	1,3,6,8

4

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[redacted]ormation on patent family members

[redacted]tional Application No
PCT/EP [redacted]6288

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2712449	A	19-05-1995	JP	2902284 B	07-06-1999
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